



Armed Forces College of Medicine AFCM



Thymus

Dr. Hanan A Saleh

Professor of Histology

INTENDED LEARNING OBJECTIVES (ILO)



- **By the end of this lecture you should be able to:**

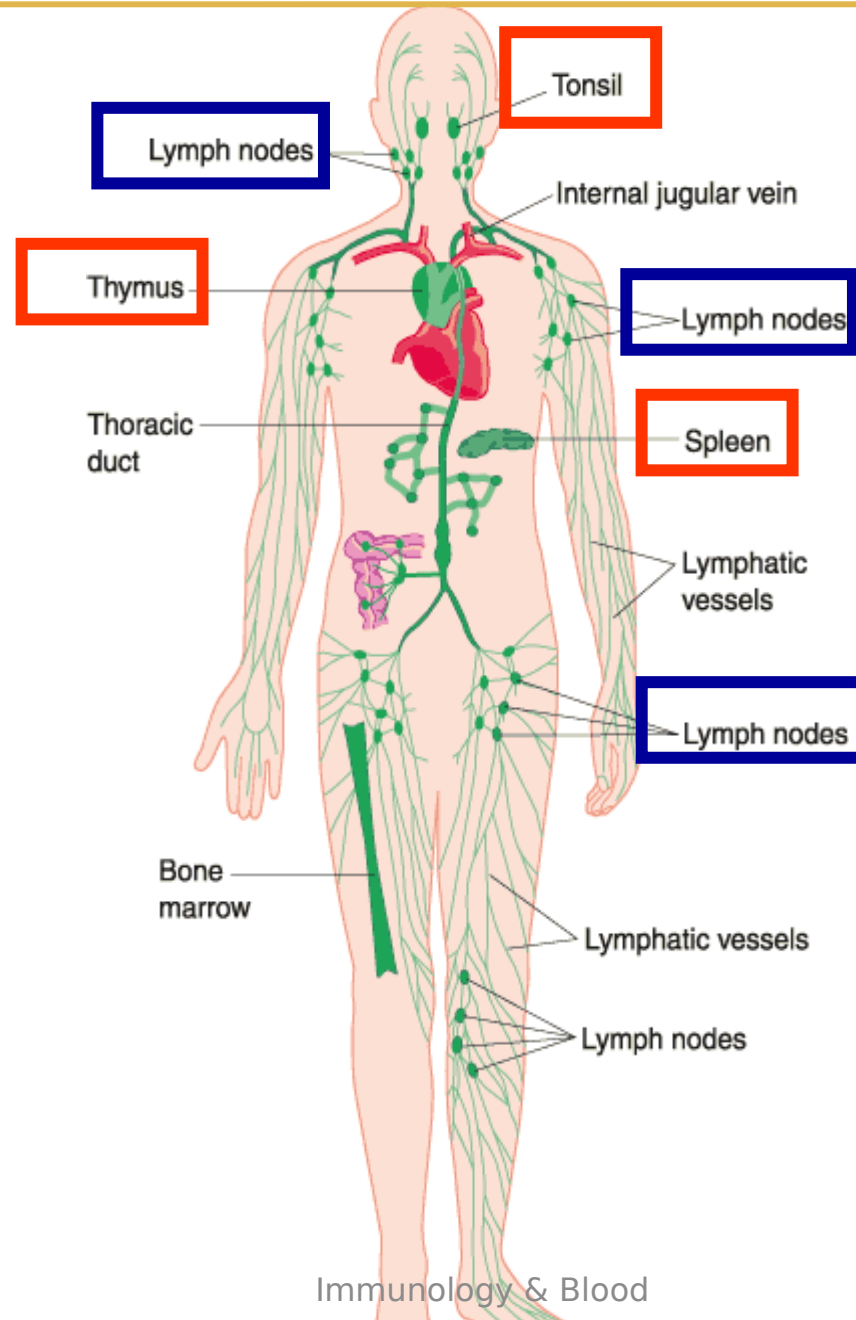
1. Describe the microscopic structure of the thymus (medulla of the thymus**).**

2. Correlate the structure of the thymus to the **function.**

3. Correlate the structure to the function of the **blood thymus barrier.**

4. Interpret the defects in structure of

The Lymphatic System



LYMPHOID TISSUE



```
graph TD; A[LYMPHOID TISSUE] --> B[I. capsulated]; A --> C[II. Non Capsulated]; B --> D[Thymus]; B --> E[Lymph node]; E --> F[Spleen]; C --> G[Solitary]; C --> H[Aggregated];
```

The diagram is a hierarchical flowchart. At the top is a purple box labeled 'LYMPHOID TISSUE'. An orange line connects it to two boxes below: 'I. capsulated' (orange) on the left and 'II. Non Capsulated' (light grey) on the right. From 'I. capsulated', a blue line leads to 'Thymus' (red), which then leads to 'Lymph node' (red), which finally leads to 'Spleen' (red). From 'II. Non Capsulated', a blue line leads to two boxes: 'Solitary' (light grey) and 'Aggregated' (light grey).

I. capsulated

Thymus

Lymph
node

Spleen

II. Non Capsulated

Solitary

Aggregated

The Thymus



- **Bilobed organ.**
- **Large early in life and involutes near the age of puberty.**
- **Is the primary or central lymphoid organ for → T cell education.**
- **Derived from**
 - **- Endoderm (epithelial reticular cells)**
 - **- Mesoderm (lymphocyte)**

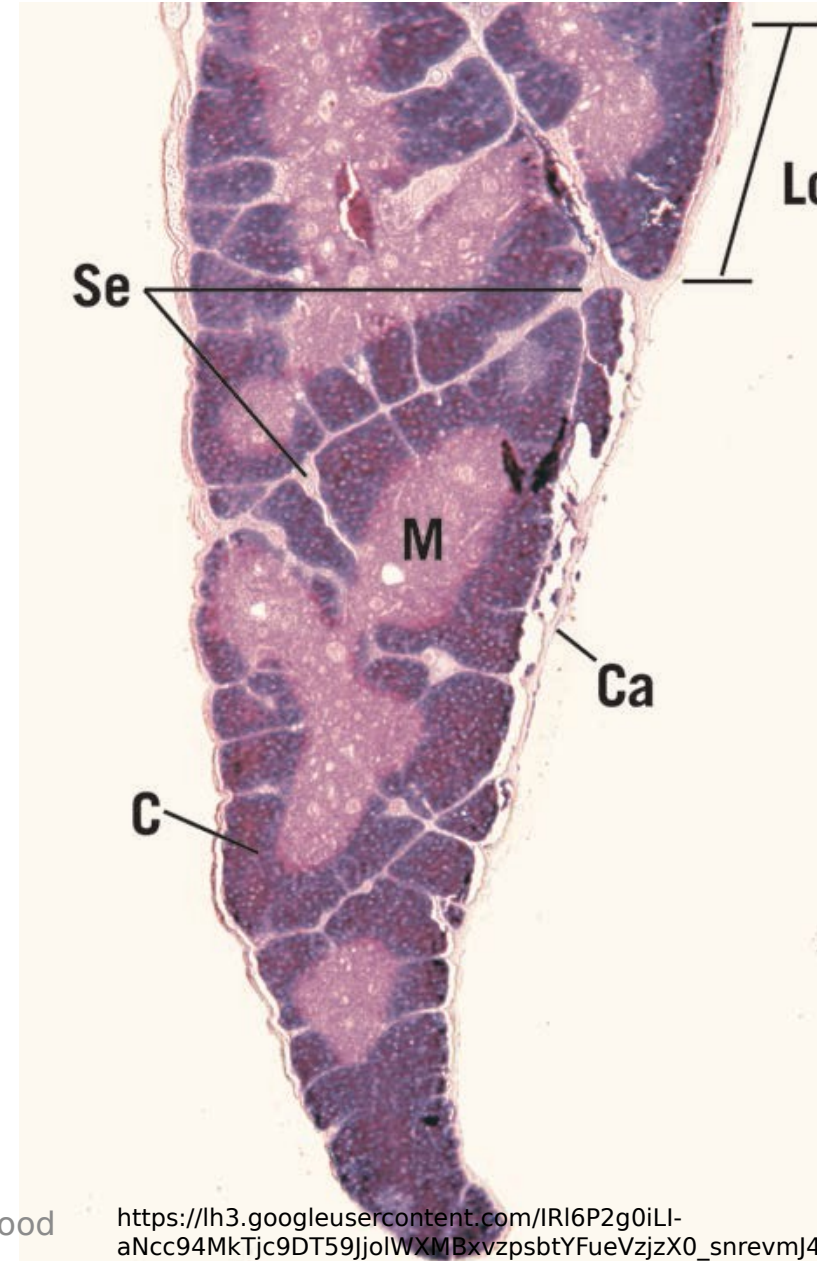


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The Thymus



- Stroma
- Parenchyma



The Thymus



■ Stroma

1. **Capsule: thin**

2. **Trabeculae:** divide parenchyma into **incomplete lobules** so that there is continuity between the cortex & medulla of adjacent lobules.

■ **The reticular stroma that support the parenchyma of the thymus is formed by Epithelial-Reticular Cells (ERCs)**

CYTORETICULUM



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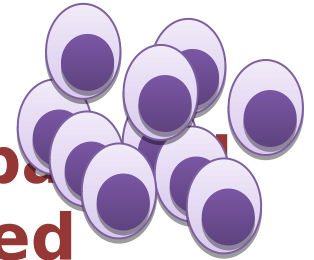
The Thymus



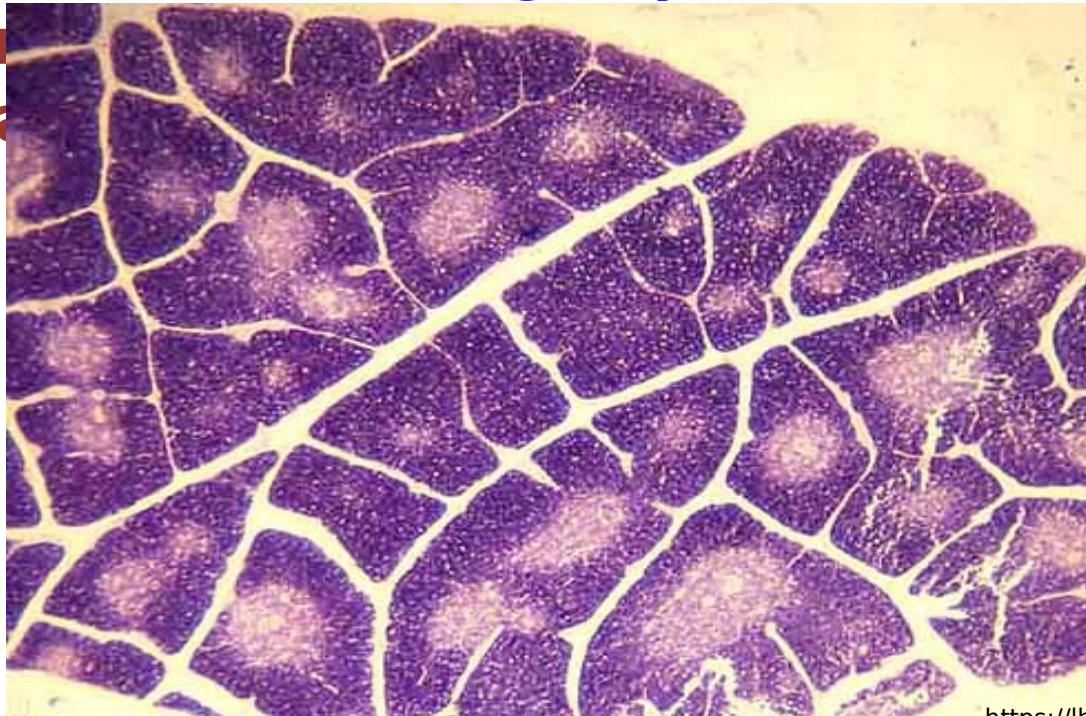
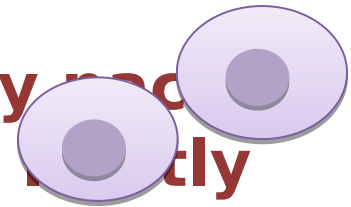
- ❑ Parenchyma

- ❑ Each lobule is formed of:

1. Cortex → darkly stained → closely packed small T lymphocytes with darkly stained nuclei.



2. Medulla → lightly stained → loosely packed with large, pale-stained cells.



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Blood vessels

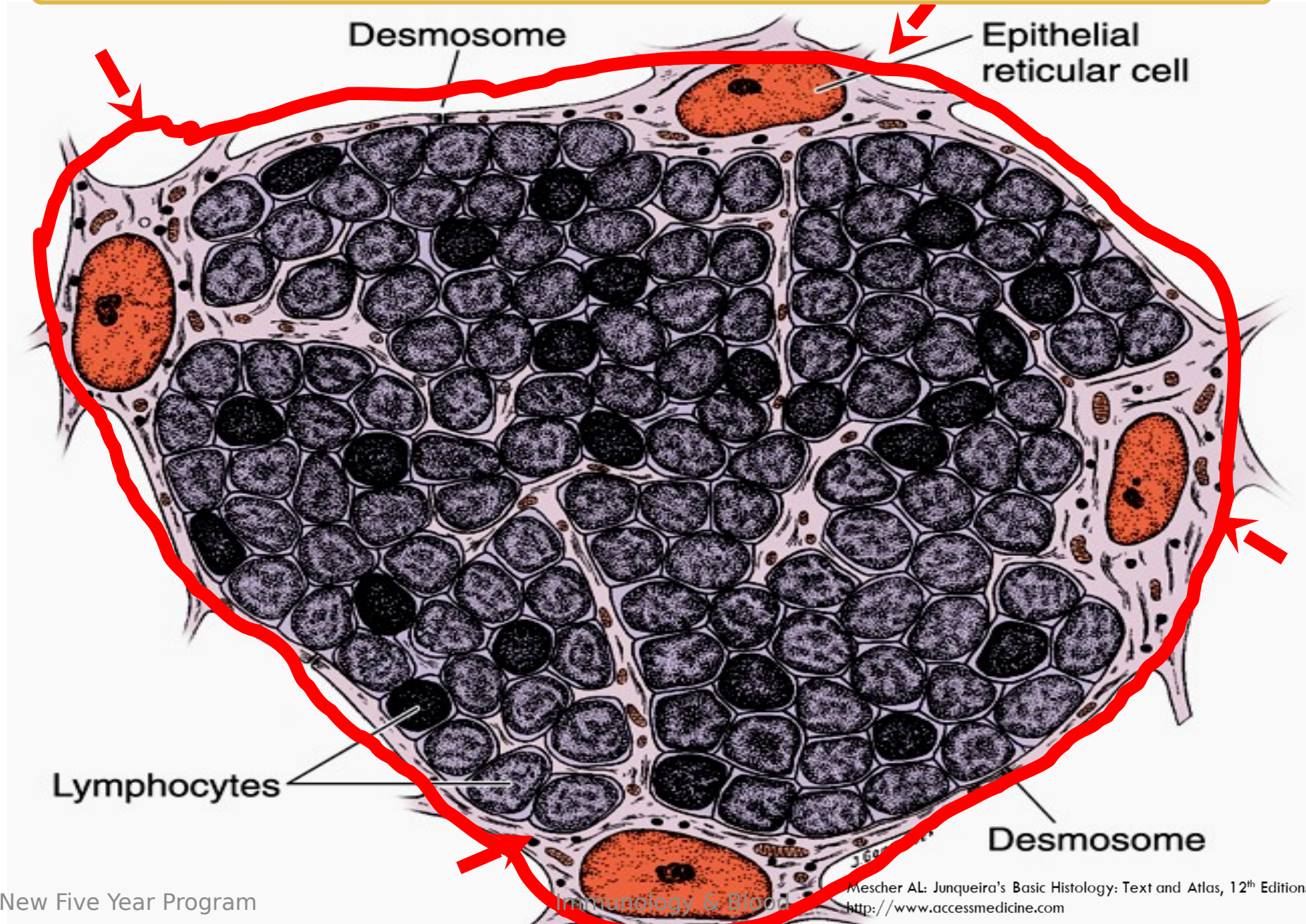
This histological image shows a cross-section of a lymph node. The tissue is stained with hematoxylin and eosin (H&E), giving it a blue and pink appearance. The lymph node is divided into an outer cortex and an inner medulla. The cortex is densely packed with lymphocytes, while the medulla contains medullary cords and medullary sinuses. Blood vessels are visible as clear, circular spaces. A red outline highlights the medulla, and a cyan outline highlights a single medullary cord. A red arrow points to the outer boundary of the lymph node.

Medulla

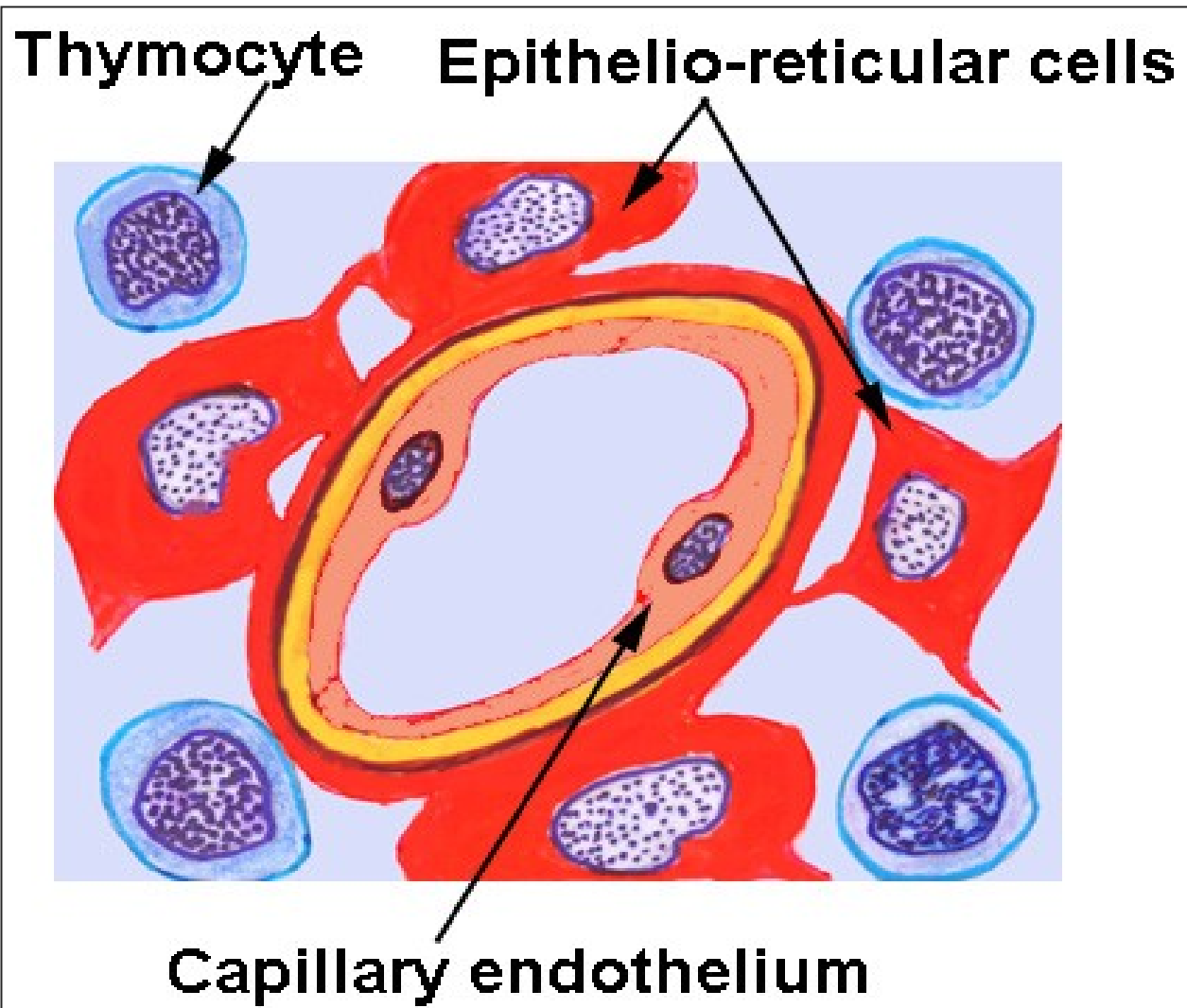
Cortex

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The Cortex of the Thymus



Blood Thymus Barrier

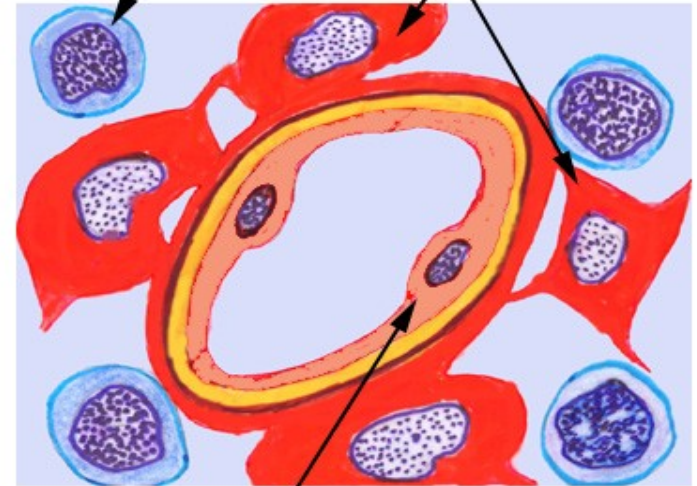


Blood Thymus Barrier



- Present in the **cortex** making it an immunologically protected region.
- Formed of:
 1. **Endothelium (continuous type)**
 2. **Thick basement membrane**
 3. **Perivascular C.T. with macrophages**
 4. **Basement membrane of ERC**
 5. **ERC Type I (epithelial**

Thymocyte Epithelio-reticular cells



Capillary endothelium

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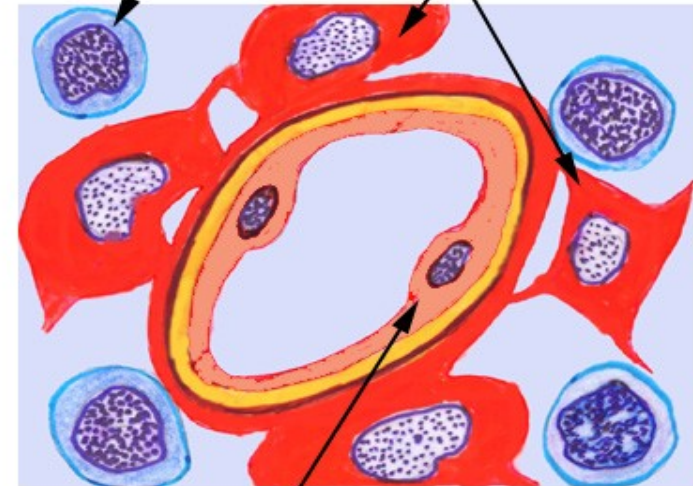
Function: Prevents the contact between Ags in blood stream and developing T-cells in the thymic cortex.

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Capillary endothelium

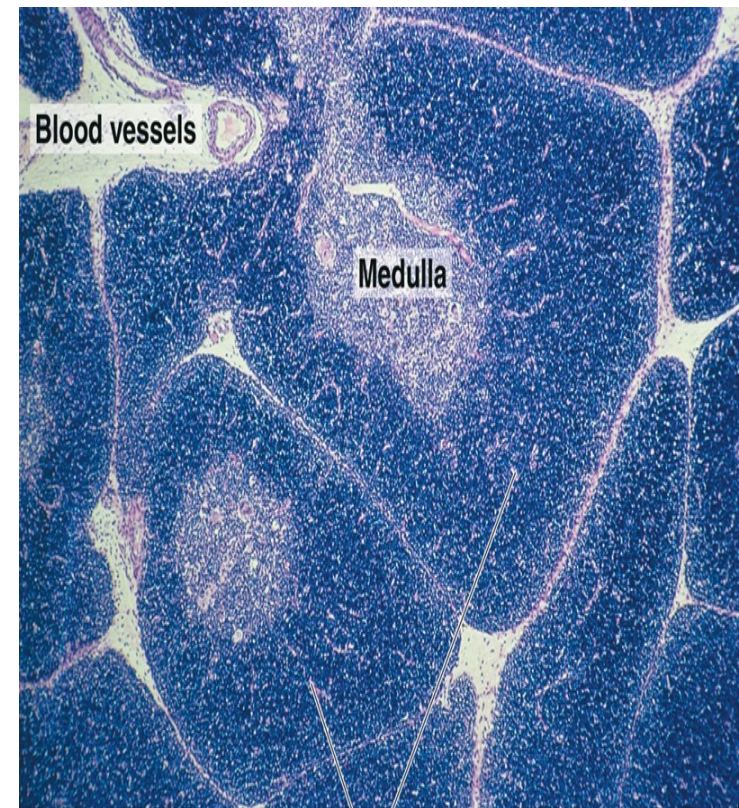
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The Medulla of the Thymus

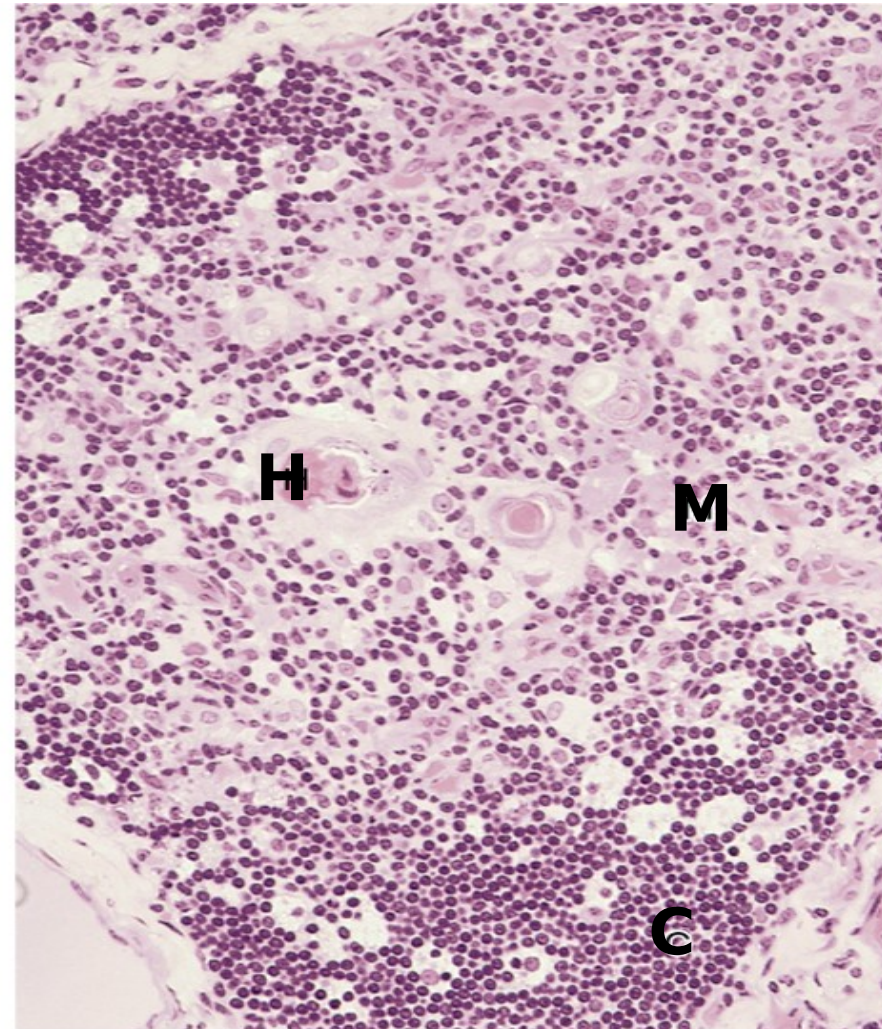
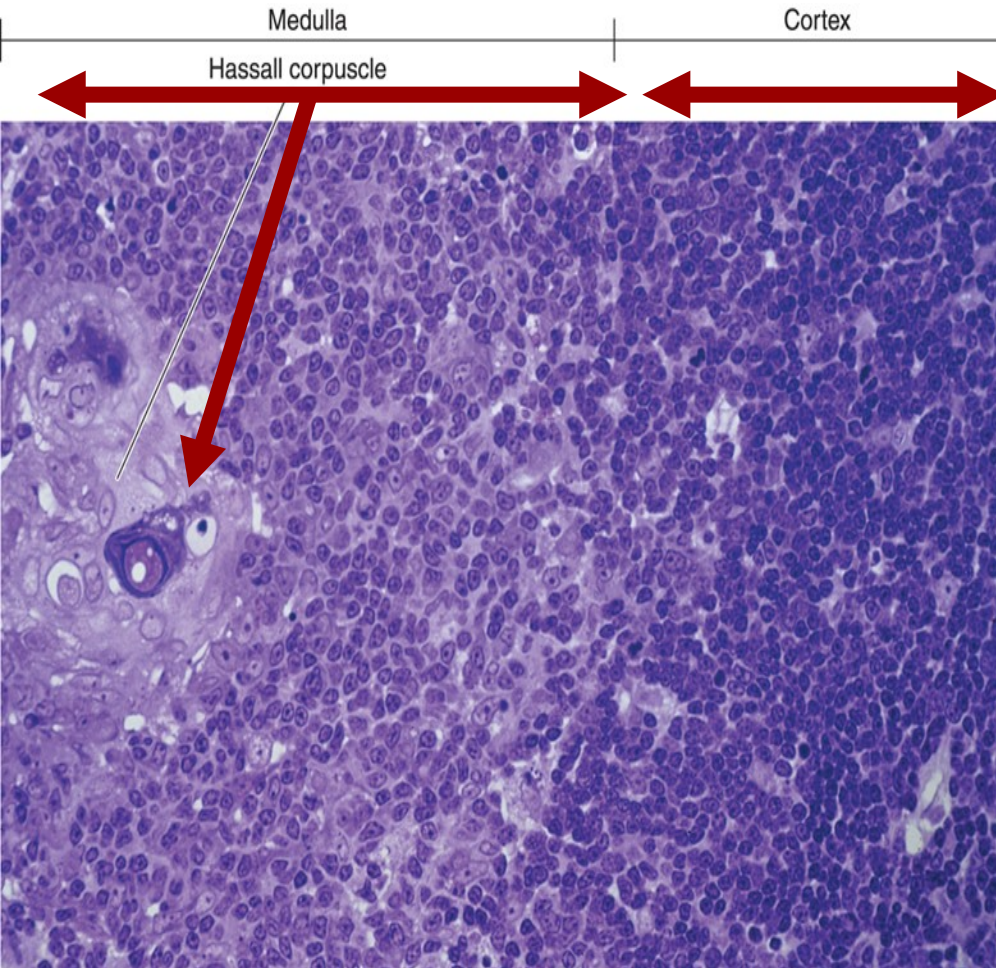


- It is the central pale area of the thymus lobule.
- Contains:
 1. Epithelial reticular cells (IV,V,VI) _
 2. Mature T-lymphocytes
 3. Hassal's Corpuscle
 4. Macrophages



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The Medulla of the Thymus

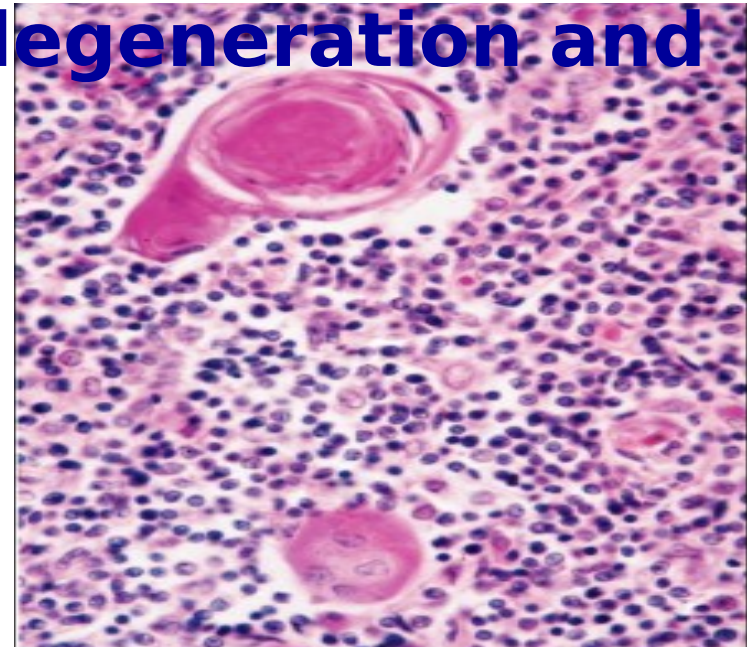


© Elsevier. Gartner & Hiatt: Color Textbook of Histology 3E - www.studentconsult.com

Hassal's Corpuscle

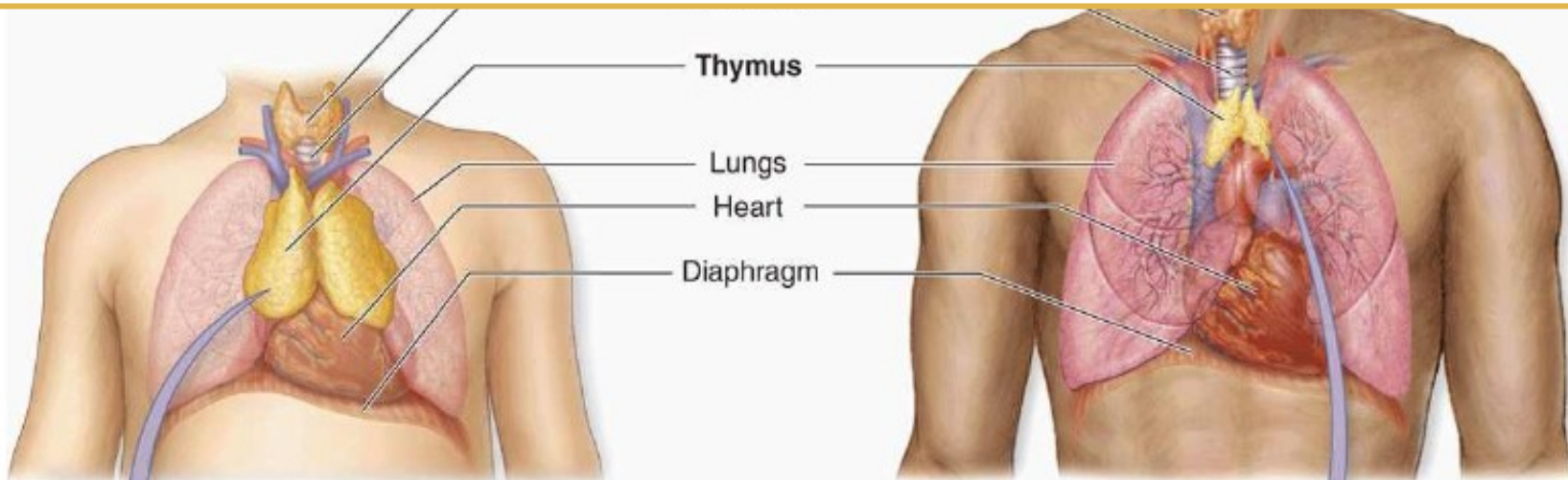


- Formed of concentric layers of **ERC** around a **central hyaline acidophilic mass** in the medulla.
- Formed as a result of degeneration and calcification of **ERC VI**.
- They increase in number with age.
- **Function:** their cells secrete several **cytokines** that promote development of T cells

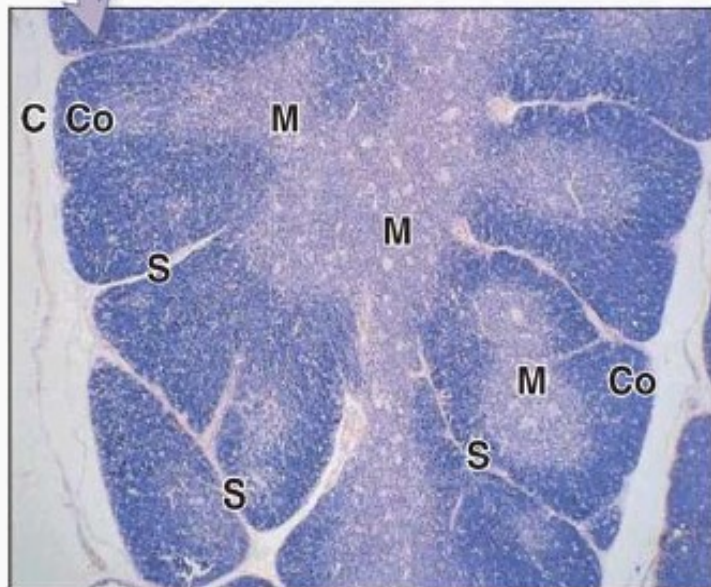


Ross MH, Pawlina W: Histology A Text & Atlas with correlated Cell & Molecular Biology, 6th Edition.

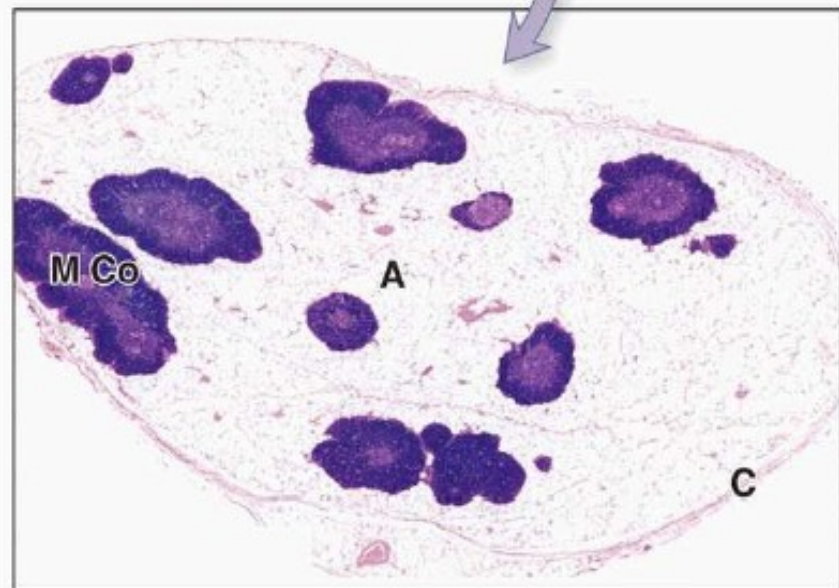
Effect of Age on Thymus Size



a Child (left) and adult (right) thorax, anterior view

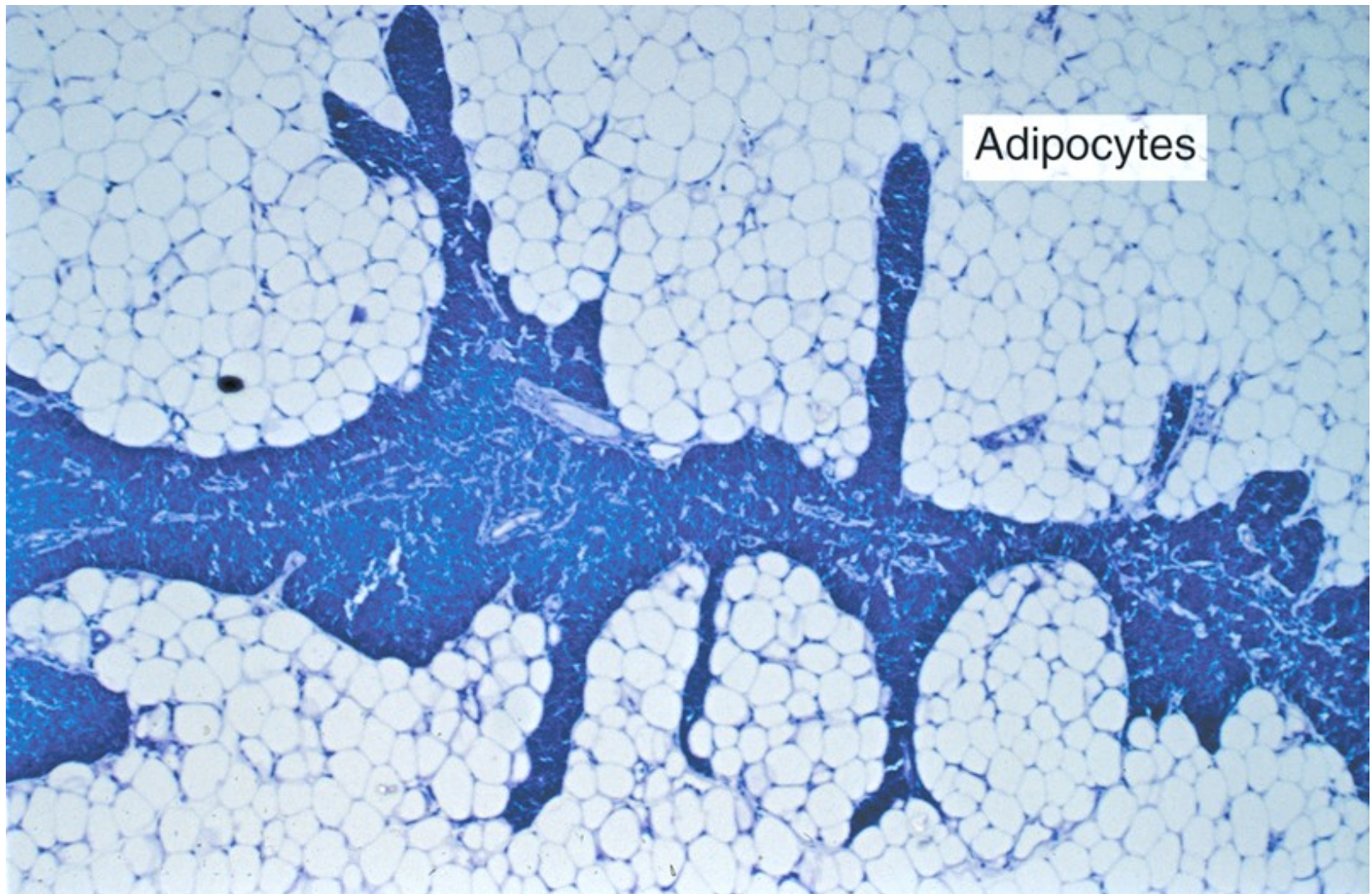


b Micrograph of child's thymus



c Micrograph of adult's thymus

Thymus in Old Age



Functions of the Thymus



1. Proliferation and differentiation of T-cells in the cortex
blood stream
dependent zones.

immunocompetent thymus

2. Thymic epithelial reticular cells secrete several hormones or factors which stimulate the differentiation of T-lymphocytes.

How are the T lymphocytes protected during their differentiation in the cortex?...

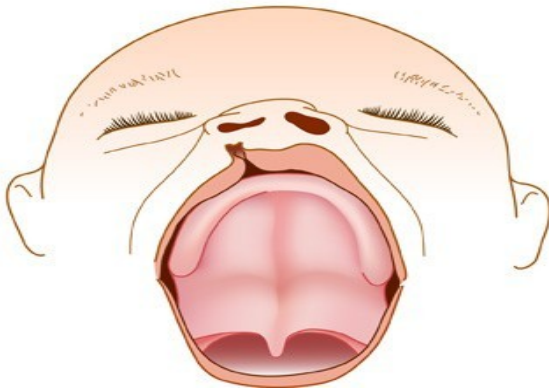
3. Blood thymic barrier

4. Thymus has NO afferent lymphatics



Clinical Correlation

DiGeorge Syndrome



Thymic hypoplasia due to failure of development of 3rd & 4th pharyngeal pouches. It is a genetic disease.

Lack of all types of ERCs → improper development of T lymphocytes → severe depression of cell-mediated immune response.

(Decreased calcium level, cleft palate, cleft lip, heart defects)

Questions

Question



- **The thymic cortex is characterized by all the following EXCEPT:**

- 1. It is the site of maturation of T lymphocytes.**
- 2. Its epithelial reticular cells secrete thymosin.**
- 3. It contains acidophilic Hassall's corpuscles.**
- 4. It is the outer dark region of the**

Question



- **Which of the following is TRUE about the blood thymus barrier?**

- 1. It is present in the medulla of the thymus.**
- 2. It has a thin discontinuous basal lamina.**
- 3. The endothelium of blood capillaries is fenestrated.**
- 4. It is surrounded by complete layer of epithelial reticular cells.**

Question



- **The medulla of the thymus contains:**

- 1. B lymphoblasts**
- 2. ERCs type VI**
- 3. T lymphoblasts**
- 4. ERCs type I**

Lymph node



**Write the 2
main features
in each zone of
the lymph node**

Parenchyma

Cortex

Paracortex

Medulla

Question



• **The splenic blood sinusoids are characterized by which of the following?**

- 1. Are found in marginal zone.**
- 2. Have continuous basal lamina.**
- 3. Supported by collagen fibers type I.**
- 4. Are lined by longitudinally arranged endothelial cells.**

Question



• **The periarterial lymphatic sheath is the site where:**

1. Phagocytosis of RBCs occurs

2. T lymphocytes are numerous

3. Lymphocytes leave the blood and enter the spleen

4. Filtration of lymph occurs

Question



- **The periarterial lymphatic sheath is the site where:**

- 1. Phagocytosis of RBCs occurs (red pulp)**
- 2. T lymphocytes are numerous**
- 3. Lymphocytes leave the blood and enter the spleen (marginal sinus)**

Question



Most of T lymphocytes die in the cortex by the process of

Apoptosis

.....

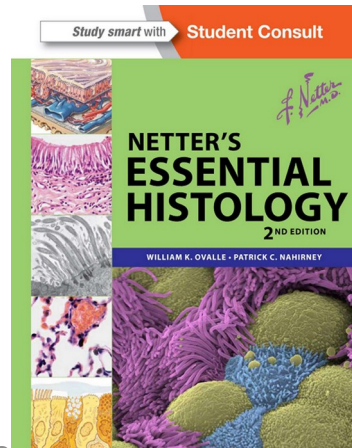
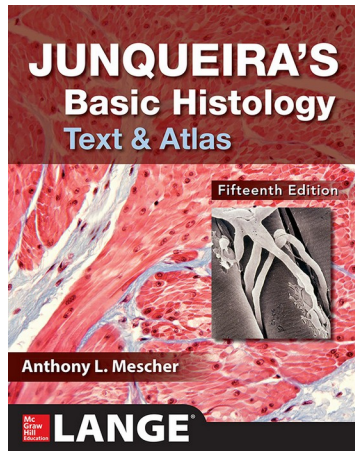
What are the components of the blood vessel wall?

- 1. Endothelium (continuous type)**
- 2. Thick basement membrane**
- 3. Perivascular C.T. with macrophages**
- 4. Basement membrane of ERC**
- 5. ERC Type I**

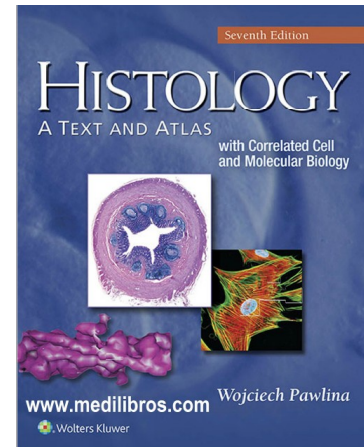
SUGGESTED TEXTBOOKS



1. **Junqueira's Basic Histology: Text and Atlas, 16th Edition by Anthony Mescher, 2018.**
2. **Michael H. Ross & Wojciech Pawlina (2024), Histology Text and Atlas with correlated cell and Molecular Biology, 7th Edition.**



Endocrine & Genitourinary Module





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